

# MOTOR VEHICLE COMPRISING A DISPLACEABLE ROOF SECTION

## BACKGROUND OF THE INVENTION

### Field of the Invention

[0001] The invention relates to a motor vehicle comprising at least one displaceable roof section, which when closed abuts a windshield frame at the front of the vehicle and whose lateral outer areas respectively abut a support, with the supports being at least partly relocatable in lateral columns of the windshield frame to form an open roof section.

### Description of the Related Art

[0002] DE 202 01 411 UI discloses a motor vehicle of this type, which can be developed as a convertible or a Targa vehicle, for example. With said motor vehicle, the supports, which can be relocated in the lateral columns of the windshield frame, offer a stable support for at least one displaceable roof section when the motor vehicle is closed. When the top is open after the roof section was removed either manually or stored in the rear area of the vehicle by a joint mechanism, said supports reinforce the lateral columns of the windshield frame, thus offering increased protection to the passengers when the windshield frame is bearing the load of the vehicle, as can be the case in a rollover.

[0003] With said vehicle, there is room for improvement in the guidance system of the supports when they move between a first end position in a state when they are recessed in the lateral column of the windshield frame, and a second end position at a rear roof section when the roof of the motor vehicle is closed. For one, the proposed development of the A-columns of the windshield frame having a receiving channel with

dimensions which essentially correspond exactly to the cross-orientation of the supports bears the risk of a so-called "drawer effect", i.e., a tilting of the supports on both sides when they are displaced between two end positions, and on the other hand, the stability of the roof frame construction is limited here with lateral supports abutting the rear roof section, as proposed.

**[0004]** Therefore, the problem to be solved by the present invention with a motor vehicle of the type described above is to provide an improved mechanism for the displacement of the lateral supports between their end positions with respect to protection against jamming and stability of the roof section.

#### BRIEF SUMMARY OF THE INVENTION

**[0005]** In accordance with the invention, this objective is attained by a motor vehicle ~~in accordance with the characteristics of the patent claim 1,~~ with the end of the supports in the area at the front of the vehicle being guided in a receiving channel formed by the assigned lateral column of the windshield frame, and in the exit region at the upper end of the lateral column by a respective roller bearing without play and at a defined distance from the wall of the receiving channel.

**[0006]** In accordance with the invention, the roller bearing of the supports in the lateral columns of the windshield frame advantageously counteracts the so-called "drawer effect" and ensures a problem-free synchronous displacement of the supports arranged on both sides of the windshield frame between their end positions.

**[0007]** Furthermore, the object of the invention is attained with the development of a motor vehicle ~~according to the characteristics of the patent claim 8,~~ which provides the support at the rear of the vehicle to be held in a central manner in a locking device at

a rear roof section, and with said locking device being designed with a cylindrical fastening element comprising a centering recess in which a rocker-mounted locking lever is arranged, which is designed to engage in a recess at the end of the support at the rear of the vehicle in locking position.

[0008] This development of the contact area between the lateral support and the abutting roof section when the roof section is closed allows a secure detention of the lateral support at the rear roof section in a constructively simple manner, which increases the stability of the roof when the top is closed.

[0009] The same is achieved with an alternate design ~~in accordance with patent claim 13~~ by arranging a longitudinal slide element, which is connected to a snap-in element, in the cylindrical fastening element of the locking means. When said longitudinal slide element is displaced, the snap-in element engages in a snap-in recess at the end of the support at the rear end of the vehicle or releases the same.

[0010] An especially secure guidance system of the supports between their end positions is achieved by the combination of a roller bearing of the supports in the lateral columns of the windshield frame ~~according to the characteristics of the patent claim 1~~ and a centered guidance system and locking of the supports at the rear roof element ~~in accordance with the characteristics of the patent claims 8 or 13.~~

[0011] Other advantages and advantageous developments of the object of the invention can be found in the description, the ~~illustration~~ figures and the patent claims.

[0012] Two embodiments of a motor vehicle designed in accordance with the invention are shown in a simplified schematic representation in the ~~illustrations~~ figures and explained in greater detail in the following.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The ~~illustrations~~ figures show:

[0014] ~~III, Fig. 1~~ a motor vehicle in accordance with the invention, in "Targa" construction method with closed roof represented schematically in a lateral view;

[0015] ~~III, Fig. 2~~ the motor vehicle in accordance with ~~III, Fig. 1~~ with the roof open;

[0016] ~~III, Fig. 3~~ a diagram of the lateral view of an additional motor vehicle in accordance with the invention in convertible construction with a roof cover that can be completely stored in a storage housing in the rear area of the vehicle, which is shown in ~~III, Fig. 3~~ in two different positions during the opening- or closing process;

[0017] ~~III, Fig. 4~~ a partially opened top view of the vehicle in accordance with ~~III, Fig. 3~~;

[0018] ~~III, Fig. 5~~ a three-dimensional detailed view of a sleeve-like housing part of a lateral column of a windshield frame with a roller bearing to guide an assigned support;

[0019] ~~III, Fig. 6~~ a top view of the end of a support at the front of the vehicle with a roller bearing;

[0020] ~~III, Fig. 7~~ a three-dimensional lateral view of the roller bearing in ~~III, Fig. 6~~ shown separately;

[0021] ~~III, Fig. 8~~ a diagram of a longitudinal section through the end of a support at the rear of the vehicle and a first embodiment of a fastening element of a locking means at a rear roof section; and

[0022] ~~III. Fig.~~ 9 a diagram of a longitudinal section through the end of the support at the rear of the vehicle according to ~~III. Fig.~~ 8 and a second embodiment of the fastening element of the locking means at the rear roof section.

#### DETAILED DESCRIPTION OF THE INVENTION

[0023] The ~~illustrations~~ figures 1 to 3 show sections of a motor vehicle 1 having a roof 2. When the roof 2 is closed, it abuts a windshield frame 3 at the front of the vehicle, which encompasses a windshield 4 and comprises lateral columns 5 and an upper cross-frame part 6, which form the A-columns of the motor vehicle 1.

[0024] The present roof 2 has a movable roof section 7 which, when the roof 2 is closed, abuts lateral supports 8 which stabilize the roof 2. At the rear, the movable roof section 7 connects to a rear roof section 9.

[0025] In the embodiment according to ~~III. Fig.~~ 1 and ~~III. Fig.~~ 2, where the motor vehicle 1 is developed in the "Targa" construction method, the rear roof section 9 is arranged rigidly and developed with a rear window 10. The moveable roof section 7, which can be of metal or plastic or acrylic glass or the like, can be removed completely here manually to form an open roof section 2. After the movable center roof section 7 has been removed and thus leaves a roof opening 2A, the lateral supports ~~7-8~~, which are now no longer needed, can be lowered into the lateral columns 5 of the windshield frame 3 by opening a locking means 11 in its contact area with the rear roof section 9.

[0026] The ~~illustrations~~ figures 3 and 4 show another development of a motor vehicle 1' configured as a convertible. Here, the movable roof section 7' slides over the rear roof section 9' during the opening movement of the roof 21 and then both roof

sections 7', 9' are displaced downward around a common pivot axis 32 located at the rear of the motor vehicle 1' and into a housing. Any arbitrary known lever mechanism can be used for this purpose.

[0027] It goes without saying that alternate embodiments of the two configurations of the motor vehicle 1 and/or 1' shown above may also provide a plurality of movable roof sections, and that the rear roof section can comprise a plurality of segments.

[0028] In the shown embodiments, the lateral columns 5 form a respective receiving channel 12 to accommodate the support 8 when the roof 2 and/or 2' is open, with the end of said respective support 8 being guided at the front of the vehicle by a first roller bearing 13 and in the area of its exit region from the upper end of the lateral column 5 by a second roller bearing 14 without play and at a defined distance to the wall of the receiving channel 12.

[0029] The ~~illustrations~~ figures 6 and 7 in particular show in detail that in the shown embodiment, the support 8 has at its end at the front side of the vehicle an at least approximately radial holding means 15 to configure the first roller bearing 13 at the front of the vehicle, with three coplanar roller bearings 16 being held at the teeth of said holding means 15.

[0030] The number of rollers 16 running at the interior wall of the receiving channel 12, which in the present case represent wheels formed by a rubber-like material, can vary randomly in embodiments that deviate from the preferred shown three point bearing.

[0031] ~~Illustration~~ Figure 5 in particular shows that the second roller bearing 14, which is assigned to the exit region where the support 8 exits the lateral column 5, is arranged in the area of a drive means 17 for the support 8. The drive means 17 comprises a toothed batten 18 formed on the support 8 in longitudinal direction of said support and a pinion 20 which engages therewith and can be driven by a drive motor 19.

[0032] In the present case, the second roller bearing 14 is formed by four rollers 21 developed as cylinders, which guide the support in the area where it exits the lateral column 5, in addition to the pinion 20 of the drive means 17. The rollers 21 are arranged circularly in a sleeve-like housing part 23 in the area of a shoulder 22 which forms a stop which determines the end position of the support 8 at the rear of the vehicle.

[0033] The sleeve-like housing part 23 is usefully developed as a separate component which can be fastened at the lateral column 5 of the windshield frame 3 with three screw connections 25, as shown in ~~III~~ Fig. 5.

[0034] In the embodiments shown above, the electrical drive motor 19 is the central drive motor for both supports 8, which is why it is arranged essentially in a central manner in the motor vehicle at the windshield frame 3 and connected to the respective pinion 20 cooperating with the support 8 through appropriately curved shafts 24 in transverse direction of the vehicle.

[0035] In addition to the roller bearing of the supports 8 in the lateral columns 5 of the windshield frame 3, the use of a central drive motor further counteracts a "drawer" effect in the movement of the supports 8 in the lateral columns 5 because the synchronized movement of the two supports 8 avoids a tilting or jamming as a result of a varying drive of the supports.

[0036] With an appropriate compulsory synchronization, this effect can also be obtained with the use of two drive motors, if necessary, although this solution requires a greater effort.

[0037] Instead of driving the supports 8 with an electrical drive motor, an alternate embodiment may also provide a hydraulic or pneumatic drive. It is also possible to provide the displacement of the supports 8 manually without a drive motor.

[0038] In the embodiment of the motor vehicle 1' as a convertible in accordance with ~~illustrations~~ figures 3 and 4, the front end area of the movable roof section 7' is connected to a sleeve 27 which partially or completely encompasses the support 8 through an elastically deformable connection 26, which in the present case is a spring steel-sheet.

[0039] Alternately, another embodiment may also provide that the movable roof section is connected to the sleeve by means of a steering triangle provided for each side of the motor vehicle with a spherical head bearing at the movable roof section.

[0040] In the shown embodiment, the sleeve 27 has a recess through which a pinion 28 can engage with the groove-like tooth batten 18 of the support 8.

[0041] The sleeve 27 is held on the support 8 nearly without play and can move longitudinally on said support, thus allowing the longitudinal displacement of the center roof section 7', which hangs on the sleeve 27, by means of a manual drive or drive by the pinion 28. In order to avoid a collision between the center roof section 7' and the roof section 9' located behind said center roof section in the opening movement of the roof 2', a pivotably arranged erector 30 is provided in a lateral frame section 29, which can be pivoted transversely to the longitudinal axis of the lateral frame section to lift the rear



section of the roof section 7' when said roof section is displaced to the rear and thus allow the overtravel of the rear roof section 9'. The erector 30 and the pinions 28 are respectively synchronized separately.

[0042] The end of the support 8 at the rear of the vehicle has a tapered section 31 which is provided as a receptacle on a first embodiment of the locking means 11 according to ~~Fig.~~ Fig. 8 or a second locking means 11' according to ~~Fig.~~ Fig. 9 at the rear roof section 9'. In the present case, the tapered section 31 is developed in the simplest manner as a separate component placed on the end of the support 8 at the rear section of the vehicle and riveted thereto. It goes without saying that an expert can also select another suitable configuration here, with a partial spherical form being provided instead of a tapered form.

[0043] The locking means 11 and/or 11' is developed with a cylindrical fastening element 34 and/or 34' which essentially represents a cylindrical turning part through which the ~~sleeve 27~~ tapered section 31 can be guided and which has a centering recess-- in this case a receiving taper, i.e., recess cone 33 and/or 33'--for the end of the support 8 at the rear of the vehicle.

[0044] A rocker-like locking lever 35 is arranged in the fastening element 34 shown in ~~Fig.~~ Fig. 8, which is designed to engage in a recess 36 at the tapered end 31 of the support when the locking means 11 is in a locked position. To engage in the recess 36, which in the present case is configured as a cross-hole at a screwed-in end extension 37 of the support 8, the locking lever 35 has a hook 38 on its end facing the support 8.

[0045] The locking lever 35 is positioned in the fastening element 34 so that it is transferred from a resting position into the locking position when the tapered end 31 of

the support 8 is inserted into the receiving taper 33 of the fastening element 34, for which the end 35A of the locking lever 35, which faces the support 8, cooperates with a spring 39, and the end 35B, which faces away from the support 8, cooperates with the sleeve 27, which is guided on the fastening element 34 and connected to the rear roof section 9'.

[0046] In non-locking state of the locking means 11, the sleeve 27 is held axially by a detention means 40 at the end facing the support 8. The detention means 40 is developed with a lever element 41 which in the non-locking state of the locking means 11 projects with a first lever end 41A into the receiving taper 33 of the fastening element 34 and is displaced with a second lever end 41B by the force of a conveying spring element 42 into a position that projects over the outer circumference of the cylindrical fastening element 34 and holds the sleeve 27 axially.

[0047] When the tapered end 31 of the support 8 is guided into the receiving taper 33 of the fastening element 34, the tapered end 31 of the support 8 applies force to the first lever end 41A of the lever element 41 and causes it to pivot in its pivot point against the force of the spring element 42 so that the second lever end 41B is located within the outer circumference of the fastening element 34 and the sleeve 27 can slide over it in the direction of the support and release the locking lever 35. When the sleeve 27, which is now free to move longitudinally, moves forward and/or in the direction of the support 8, it releases the end 35B of the locking lever 35, which faces away from the support 8, and said locking lever is pivoted by the force of the spring 39 so that the end 35A, which faces the support 8, and the hook 38 are pressed into the recess 36 at the tapered end 31 of the support 8.

[0048] In this locked state, the support 8 provides a stable connection between the lateral column 5 of the windshield frame 3, which forms an A-column, and the rear roof section 9.

[0049] To unlock the locking means 11, the sleeve 27 is displaced analogously toward the rear of the vehicle, with the sleeve 27 over-traveling the lever element 41 of the detention means 40 and pressing against the end 35B of the locking lever 35 which faces away from the support 8, so that the locking lever 35 and its end 35A, which faces the support 8, is pivoted against the force of the spring 39 out of engagement with the recess 36 at the tapered end 31 of the support 8 and thus releases the support 8.

[0050] After the release of the supports 8 arranged at both sides of the motor vehicle 1', the roof 2' can be folded to form the roof opening 2A, and the supports 8 can be lowered into the lateral columns 5 of the windshield frame 3. After the support 8 has been lowered into the lateral column 5, it can be locked in the present case by a self-retention of the drive means 17, but it is also possible to provide any other suitable locking means that secures the support 8 in its second end position.

[0051] In the embodiment of the locking means 11' according to ~~FIG.~~ Fig. 9, the support 8 again has on its end at the rear of the vehicle a tapered or, if applicable, semi-spherical section 31 which is provided for acceptance in a receiving taper 33' of the locking means 11' mounted at the rear roof section 9'. Here too, the receiving taper 33' is developed at a cylindrical fastening element 34', in which a longitudinal slide element 44 connected to a snap element 42 56 is arranged. When said longitudinal slide element is displaced, the snap element 42 56 engages in a snap recess 43 at the tapered or semi-spherical end of the support 8 or releases the same.

[0052] The snap element 42 56 and the longitudinal slide element 44 represent components of a joint mechanism 45 which furthermore has a lever 46 that connects said two elements of the joint mechanism 45; in a longitudinal displacement of the longitudinal slide element 44 said lever is pivoted transversely between the longitudinal slide element 44 and the snap element 42 56, which is essentially arranged perpendicular thereto, thereby causing the radial displacement of the snap element 42 56 in its mounted position relative to the fastening element 34'.

[0053] The snap element 42 56 is developed like a cross-slide having a boring 49 that allows the breakthrough of an extension 48 of the support 8 and can be displaced in its mounted position so that it aligns with the boring of a cavity 50, which connects to the receiving taper 33' and is provided to hold the extension 48 of the support 8 in the locked position, or to narrow the cross-section of the boring.

[0054] In an unlocking position, the longitudinal slide element 44 is displaced into an end position and/or resting position facing away from the support 8 by the sleeve 27, which presses against a shoulder 44A of the same against the force of a spring 47. In said end position and/or resting position 42, the boring 49 of the snap element 42 56 essentially aligns with the boring of the cavity 50 and the extension 48 of the support 8 can be introduced into the cavity 50 without obstruction.

[0055] To relocate the joint mechanism 45 from said resting position into a locking position in order to achieve a firm connection between the lateral column 5 and the rear roof section 9' through the support 8, the sleeve 27 or another element provided to secure the longitudinal slide element in the resting position is driven into a position that releases the spring 47 which is acting on the joint mechanism 45, which in the

present case means a displacement of the sleeve 27 into the direction of the support 8. The spring 49 ~~47~~, which was biased earlier but is now relieved, presses the longitudinal slide element 44 into the direction of the support 8. In doing so, the snap element 42 ~~56~~ is displaced by the lever 46 from its resting position, where its boring 49 aligns with the receiving boring 50 for the extension 48 of the support 8, into a position that narrows the cross-section of the receiving channel and/or the receiving boring 50.

[0056] When the axial extension 48 of the support 8 is developed with a snap recess, as presently a clearance groove 43, and introduced into the cavity 50, the snap element 42 ~~56~~ engages in the snap recess and/or clearance groove 43 at the axial extension 48 of the support 8 and thus locks the support 8 in the fastening element 34'. This state is principally shown in ~~III~~ Fig. 9.

[0057] The sleeve 27 is guided at the fastening element 34 and/or 34' along a groove 51 outlined as an example in ~~III~~ Fig. 9, which has a tooth profile that corresponds to the tooth batten 18 of the support 8 and aligns with the tooth batten 18 of the support 8 ~~so that the sleeve 27 can be guided~~ over the groove 51 of the fastening element 34 and/or 34' as well as the tooth batten 18 of the support 8.

[0058] It goes without saying that an alternate embodiment may also provide that the sleeve has a corresponding groove and can be guided with same along a guide rail at the support and the fastening element. In both cases, the groove guidance system has the advantage of being torsion-proof.

[0059] In the shown embodiment, another identically developed groove is shown at the support 8 and at the fastening element 34 and/or 34' in mirror image to the outlined groove 51, and thus both of the lateral supports 8 and the fastening elements 34 and/or 34'

represent so-called identical parts which can be used at either side of the vehicle. By developing said components as identical parts, the costs of the roof 2 and/or 2' can be lowered significantly.

[0060] For the automated opening and closing of the roof 2', the sleeves 27 assigned to the supports 8 and the roof section 7' connected thereto are driven by motor. To that end, a servo motor 52, which is indicated in schematic representation in ~~Fig.~~ Fig. 4, is arranged at the movable roof section 7' and can be triggered wirelessly through radio or ultrasound to open and close the roof 2', and has an accumulator 53 that is charged when the roof section 7 abuts the windshield frame 3.

[0061] In an alternate development of the servo motor 52, a conductor path 54, which is arranged at the supports 8 in the running direction of the sleeve and may represent a copper rail, for example, can be loaded by the drive motor 19 with current which is picked off at the sleeve 27 by a contact element 55 developed as a sliding contact and conducted to the servo motor 52 in the roof section 7'. Grounding can be achieved at the respective other side of the motor vehicle. With the latter development, the running direction of the servo motor 52 can be changed by changing the polarity by means of a relay.

[0062] The mechanical connection between the servo motor 52 and the pinion 28 which respectively punches through the sleeve 27 can be achieved in the known manner by a curved shaft.

[0063] It goes without saying that the developments described here with respect to the development of the motor vehicle 1' as a convertible may also, if necessary and

with appropriate adaptation, be used in the development of the motor vehicle 1 as a Targa motor vehicle.

## REFERENCE SYMBOLS

- [0064]**            1, 1' Motor vehicle
- 2, 2' Roof
- 2A Roof opening
- 3 Windshield frame
- 4 Windshield
- 5 Lateral column
- 6 Cross-frame component
- 7, 7' Center movable roof section
- 8, 8' Support(s)
- 9, 9' Rear roof section
- 10 Rear windshield
- 11 Locking means
- 12 Receiving channel
- 13 First roller bearing
- 14 Second roller bearing
- 15 Holding means
- 16 Rollers
- 17 Drive means

18 Tooth batten

19 Drive motor

20 Pinion

21 Rollers

22 Shoulder

23 Sleeve-like housing part

24 Shaft

25 Screw connection

26 Elastic connection, spring steel sheet

27 Sleeve

28 Pinion

29 Frame part

30 Erector

31 End of support at the rear of the vehicle

32 Pivot axis

33, 33' Centering recess, receiving taper

34, 34' Fastening element

35 Locking lever

35A First end of the locking lever

35B Second end of the locking lever

36 Recess

37 End extension

38 Hook



39 Spring

40 Detention means

41 Lever element

41A First lever element end

41B Second lever element end

42 ~~Snap element~~ Spring element

43 Clearance groove

44 Longitudinal slide element

44A Shoulder

45 Joint mechanism

46 Lever

47 Spring

48 Extension

49 Boring

50 Cavity

51 Groove

52 Servo motor

53 Accumulator

54 Conductor

55 Contact element

56 Snap element